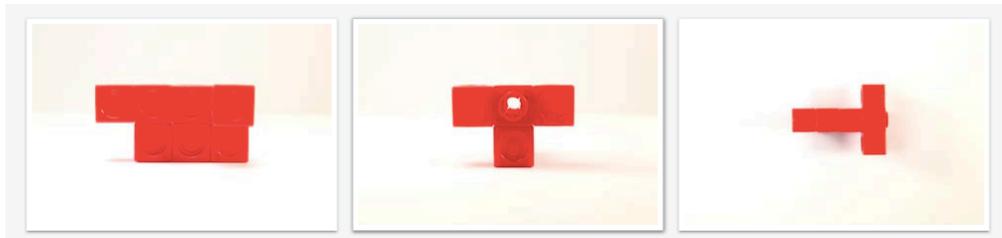


Kawartha Pine Ridge District School Board

Math for Young Children Lesson Study

June 6, 2017



Focus: Perspective Taking with K Students

Research Questions:

What are the expressive, receptive, physical, and metacognitive aspects of the development of perspective taking of K children?

- How do we develop these skills explicitly?
- How do these skills help to build empathy?

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WCDSB: Petra LeDuc

AGENDA:

1. Introductions and welcome (7 minutes)
2. Background to the project (15 minutes)
3. Learning stations: First rotation (25 minutes)
4. Learning stations: Second rotation (25 minutes)
5. School-by-school group discussion (15 minutes)
6. Whole group discussion (30 minutes)

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Social Sciences and Humanities
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Conseil de recherches en
sciences humaines du Canada

Canada

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AREAS OF EXPLORATION

Because this was a large group working together, the group further organized themselves by interest and geography.

In these smaller groups, guided play-based lesson clusters/sequences were developed, each with a slightly different emphasis:

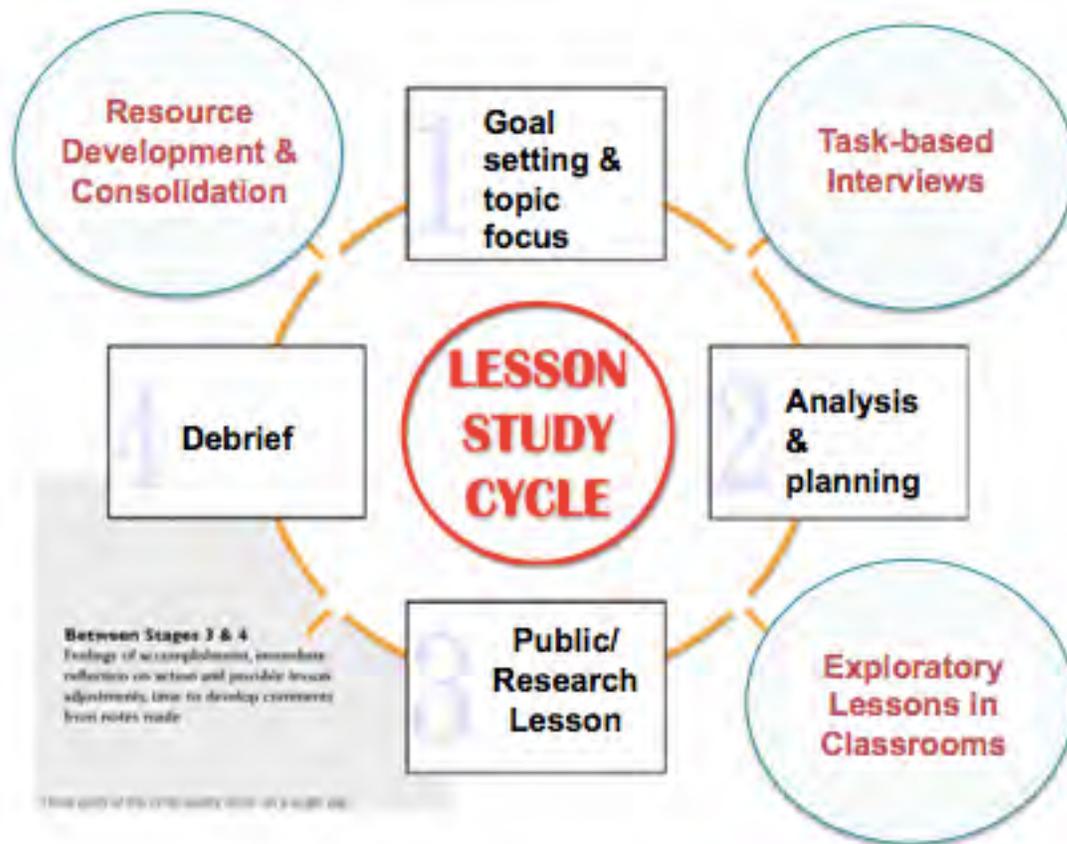
- (i) pathways, directions and orientation based on enacting a story and related games;
- (ii) top, front and side view understanding building to barrier games with an emphasis on positional language;
- (iii) an inquiry on ramp design, side views and slope, as well as emotional/social perspective taking;
- (iv) use of symmetry and barriers, with a line of reflection acting as the anchor for relative location.

BACKGROUND

In the winter and spring of 2017, a group of 20 educators from KPRDSB came together to engage in a focused study of spatial reasoning for Kindergarten students. The group consisted of representation from 7 local schools and included principals, vice principals, district consultants and kindergarten teaching teams of teachers and designated early childhood educators.

The group developed and implemented many guided-play-based tasks and activities, using a playful pedagogy with explicit math goals. The group decided that they were particularly interested in perspective taking, as a challenging goal to pursue with kindergarten students. The perspective-taking was multi-dimensional and dynamic involving physical, expressive, receptive and metacognitive aspects of perspective-taking. And this led to a wide range of task development and field testing opportunities.

The Lesson Study Process:



Why focus on math?

- Duncan et al. (2007, 2009, 2011) identified early math skills as best predictor of school success in math, language and social studies (very large scale studies)
- Math is a better predictor of language skills than early reading is ...of later language skills!
- And math is a good predictor of overall credit accumulation (Ontario data)

Why focus on early years?

- The link between socioeconomic status (SES) and school success is well established.
- Low SES differences show up as early as age 3 (Blevin, 1996 & 2008; Lefevre et al., 2009)
- Without early intervention, children of low SES and/or with math difficulties will experience a “cascade of mathematics failure” from which it is extremely difficult to recover (Jordan & Levine, 2009).

Why focus on spatial reasoning?

- Spatial reasoning is the ability to create and manipulate mental representations of actual and imagined shapes, objects, and structures (Cohen & Hegarty, 2012)
- We are mobile organisms living in a 3-D world: “spatial intelligence has evolutionary and adaptive importance.” (Newcombe & Frick, 2010)
- Empirical evidence indicates that spatial imagery reflects not just general intelligence but also the ability to solve mathematical problems, especially non-routine problems (e.g., Casey, Nutall & Pezaris, 2001; Wheatley et al., 1994)
- Spatial ability is a predictor of success in STEM disciplines (Science, Technology, Engineering and Mathematics) as well as the Arts (Newcombe, 2012, 2013; Wai, Lubinski & Benbow, 2009)
- Three reasons to pay attention to spatial reasoning in mathematics:
 - Spatial thinking and mathematic thinking (and achievement) are strongly related
 - Spatial thinking is malleable and can be improved through education and experience
 - Schools play an important role in fostering spatial thinking

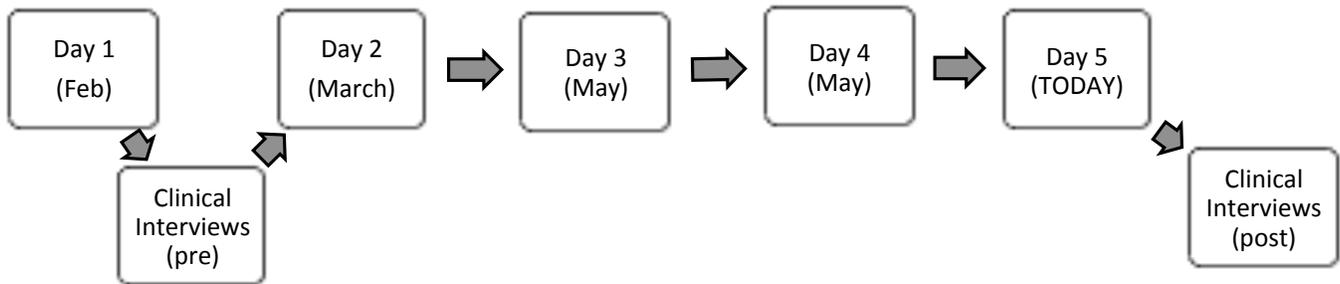
Challenges

- Some studies reflecting on preschool and kindergarten program amplification are showing that if curriculum in grade 1 and 2 is not also amplified, effects are lost by the end of grade 2 (Cannon, Jackowitz & Painter, 2006; Cooper et al., 2010)
- “Children do learn from play, but it appears that they can learn much more with artful guidance and challenging activities provided by their teachers” (Seo & Ginsburg, 2004)

5 BIG Recommendations

1. Continue to study the pedagogies involved in teaching mathematics to young children
2. Increase the focus on mathematics in educator preparation programs
3. Expand and refine the range of tools for measuring professional development outcomes
4. Push the upper boundaries of mathematics curriculum for young children
5. Advance the equity agenda, including robust implementation of researched effective interventions (Moss, Bruce & Bobis, accepted)

Our Learning Journey in M4YC



Our process: We met on 5 days as a team. In between our group meetings, we all tried many different explorations and activities in the classroom, then came back and shared our observations as a group.

The field-testing of tasks led to two outcomes: 1) ongoing revision of tasks to better meet student needs and to function fully as playful and guided tasks, and 2) a refined sense of what to do next in the classroom, resulting in a responsive planning process.

CLINICAL INTERVIEWS

1. Spatial Language
2. Number Knowledge
3. Magnitude task (Ansari)
4. 2D Mental Rotation task (Levine)
5. Perspective Taking Task:
identifying another perspective
6. Perspective Taking and Composing
Task: Lego constructions

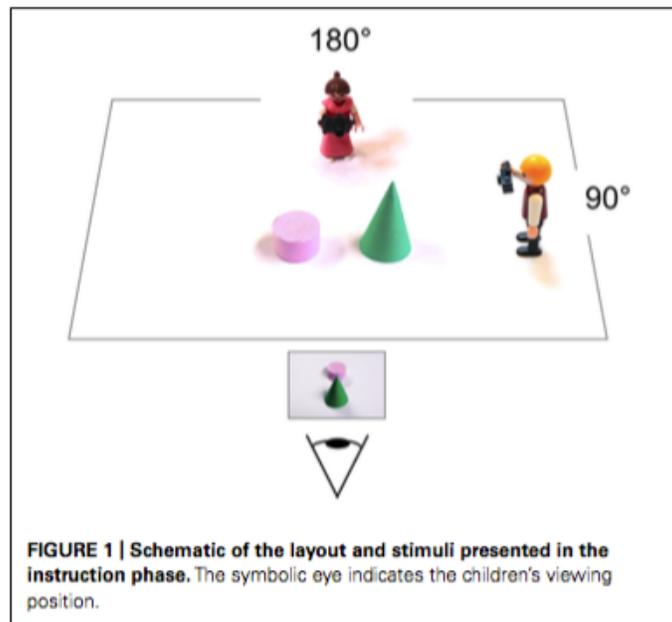
CAPTURED ON VIDEO

Clinical interviews were conducted by the research team with a range of students from each class, on a range of items. On day 1, our group became interested in perspective taking, so researchers included some perspective taking tasks to get a sense of where students were at in terms of their perspective taking.



Picturing perspectives: development of perspective-taking abilities in 4- to 8-year-olds

Andrea Frick^{1,2*}, Wenke Möhring¹ and Nora S. Newcombe¹



We became interested in research by Nora Newcombe and colleagues, who have done research to try to measure children's perspective taking. We explored ways of adapting the task to function as a series of play-based perspective taking activities.

The team identified key learnings in terms of successes and challenges:

Successes

- Language/vocab related to positional language: bottom/top/side, under
- Gesture to help with identifying location (hand gestures)
- Birds eye view (with support)
- Symmetry
- Applying to play (e.g., generalizing mapping and bringing into play)
- Persistence! Excitement and engagement with the tasks, want to be challenged, willing to self-correct
- Connecting to real world, purposeful
- Better at following instructions (following models)

- Identify features of structures and discuss/name
- Visualizing (e.g., able to trade/substitute pattern blocks)
- Noticing and describing attributes (e.g., puzzle building)
- Recognizing different perspectives (recognizing *that* someone has a different point of view)
- Math communication/math community (e.g., building on ideas)
- Orientation (using markers to orient self in the world/in relation to other things/places)
- Moving self to take a different perspective
- Representing visual information with objects
- Other math ideas and language: sorting/classifying, numeracy, counting (noticing spatial reasoning as a scaffold to other areas of math) AND other areas of perspective taking (e.g., literature, movies)
- Guided play is important!

Challenges

- Materials challenges, e.g., fine motor issues with cubes, finding the right material
- Getting them to attend to the key learning/finer details
- Certain students consistently interested/hooks all kids (small successes using materials of interest)
- Egocentrism, assuming all have the same perspective as you
- Perspective taking not transferring to social/emotional yet
 - E.g., learning how to collaborate
- Language: accessing important spatial ideas through vocabulary
 - Transferring key language/ideas to other activities/more directed situations
 - Articulating ideas about someone else's perspective
 - Initiating questions, seeking clarification
- Left/right, flips/rotations as a strategy
- JK/SK – big gap

Exploratory Tasks Set 1: Tops and Bottoms **FOCUS: Pathways, direction, and orientation**

Overall Learning Goals:

- We are learning to look at different perspectives.
- We are learning to use positional language to move from place to place.
- We are using

Success Criteria:

- I can describe different perspectives.
- I can describe movement on a grid using positional and directional language example: right, left, turn, forward, up, down
- I can describe and find the shortest pathway.

Lesson 1:

Learning Goal:

- We are learning to look at different perspectives.

Materials/preparation:

- “Tops and Bottoms” book
- paper for pictures

Lesson Overview:

1. Read: Tops and Bottoms only to the part where carrots and radishes are picked. Don't let them see the pictures.
2. Task: First ask the children to draw a picture of the setting in their minds.
3. Have them go back to their seats and draw the picture.
4. Finally, share their pictures with the group. When they share their pictures encourage them to use positional and directional language ie., right, left, turn, forward, up, down

Look fors:

- Language
- Gestures
- Accuracy

Lesson 2:

Learning Goal:

- We are learning to look at different perspectives.

Materials/preparation:

- “Tops and Bottoms” book
- chart paper
- markers
- Alternative: SMART board

Lesson Overview:

1. Read the story again from beginning to yesterday’s page: Show them the pictures this time.
2. Ask: What does bear think about himself, and of rabbit? What does rabbit think of himself and of bear?
3. Teach them the words aloof, selfish etc. These words may be introduced as you discuss the animals

Look fors:

- Can the children see rabbit and bear’s different perspectives?

Lesson 3:

Learning Goal:

- We are learning to use positional language to move from place to place.

Materials/preparation:

- Grids
- Coloured tiles
- Diamond with right, left, up, down

Lesson Overview:

1. First use tiles to make pathways from bear’s house to rabbit’s burrow. This is to allow them time to explore a grid using tiles.
2. Ask: Show the shortest route
3. Show another route
4. Show a route that has the least amount of turns
5. Show a route that has the most amount of turns
6. Task: Describe your path to bear’s house, from rabbit’s burrow using positional language right, left, forward, turn, up, down

Lesson 4: Introduce “Bearier Game”!!

Object of the game:

- Find the shortest path from rabbit’s house to bear’s house.

Materials/preparation:

- Grids 11x7
- Pentominos
- Coloured Tiles
- Picture cards showing grid set-up
- Triangles with right and left on it

Lesson Overview/How to play:

1. First look at the picture card to set your game board up with pentominos and tiles. Provide them with a diamond with right, left, up and down. Make sure the players are sitting side by side
2. Visualize the shortest path from hare's burrow through the garden to bear's farmhouse.
3. Next use tiles to make that path.
4. Finally, share with another person (teacher, friend) your path using positional language (right, left, forward, up, down)

Key Questions:

- How many moves did it take to get from Hare's burrow to Bear's den?
- Is this the shortest path? How do you know it is the shortest?
- Is there another route? How many moves would it take?

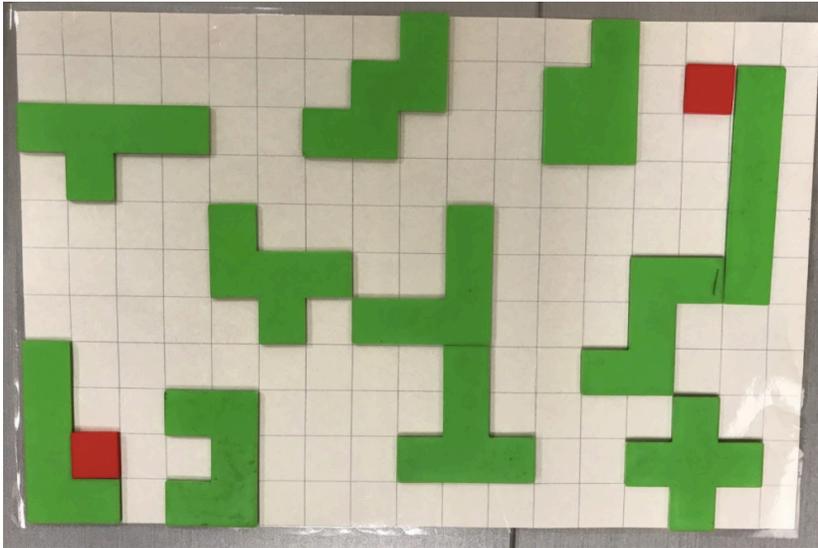
Extension:

- Show another way to Bear's house
- Make their own gardens

Listen for:

- language
- gestures
- physical movements (trying to orient themselves)

Observation Guide: See Sample Observation Guide #2



Exploratory Tasks Set 2: Bird's Eye View

FOCUS: Positional language and perspective taking

Learning Goals:

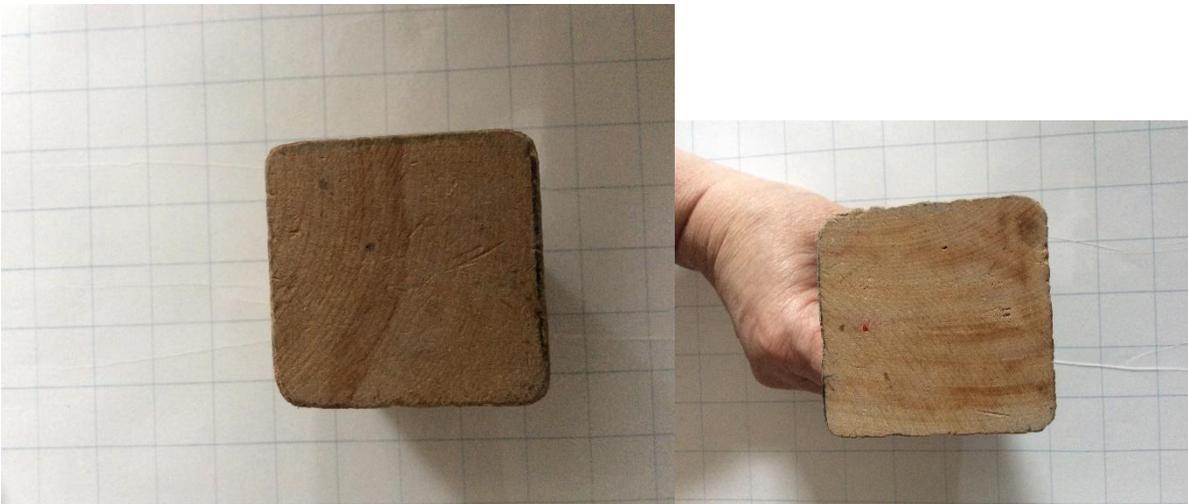
- We are learning to recognize different perspectives
- We are learning the meaning of “bird’s eye view”

Materials/preparation:

- Top view image of an object
- Various solids for students to choose from
- Grid paper (optional)
- iPad to take photos
- image set that includes top, front, side views

Lesson Overview:

1. “I took a picture from above and this is what I saw”
Show image of the top view square.
What solid could this be?
2. Provide a bunch of solids to choose from – e.g., could select cube, could select rectangular prism, could select square based pyramid. Could use a grid



3. Discuss: This is called a bird's eye view because we're looking directly from above.

4. Development (take picture of):

- The child from above
- Sand table from above
- Carpet from above
- Build a structure, then take a photo of the structure from above (then side and front)
- School from above
- Chair from above
- Shoe from above

- Open lunch from above
 - Top view of feet on the carpet
5. Here are some photos – (some would be top views as listed above but then some are side or front views)
Which of these images show top views? (sorting activity)
Why do you think that is a top view?
What makes this a bird's eye view?
6. Let's pretend we are birds and look at this little lego piece (8 dot lego piece on carpet).
What does this look like from a bird's eye view?
- Could have a cut out view finder (plate with circle cut out) to look through.
- Draw what you see (on the Smartboard, on grid paper)

Extensions:

- a) Child makes a LEGO creation and takes a top view photo. Another small group of children use that photo to try to recreate the Lego creation. There are multiple solutions with just one top view (one might be taller or have a different base; as long as the top view is the same).
- b) Draw a plan from the top view on grid paper – then try to build it (very challenging)
- c) Google map view of the school: Start with person looking at front of school – then zoom out and up to a bird's eye view of the school. Go on top of a house.

Exploratory Tasks Set 3: Building to Barrier Games

FOCUS: Perspective taking

Overall Learning Goal: for child to be able to describe location and orientation of objects so that someone else can understand; to see the parts/ and to see the whole simultaneously (sequential and simultaneous information processing – higher capacity to inference)

Activity Sequence:

1. Body benchmarks – show a picture on the Smartboard (ball is on top of the desk, put hand on top of head, put hand beside – on ribs, etc. – connect to the pictures)

2. Simon Says – outside (on top, under, beside, behind, in front) using the climber.
3. Physical hoops in the gym: each child has hoop (stand beside, in, go through, your hoop, hoop under your foot, over your head, Lie under the hoop)
4. Position and images of shoe, animal, chair, truck – Sorting game with the cards (print and make set) small group sort pictures according to the headings (front, behind, bird’s eye, bottom) Add bean bag- put bean bag inside the hoop, etc. to focus on bean bag in relation to the hoop.
5. Taking someone else’s perspective – pictures of the classroom from different perspectives- students look at pictures of the classroom and talk about where it was taken from/who can see that.
6. Build it in your mind. Which picture matches what you build in your mind? Why do you think it is this picture? Why isn’t it this picture?
7. Put the cow beside the Barn, in the barn, on the barn, on the barn.
8. Repeat #7 with shapes.
9. Gestalt exercise: SAY what the overall structure looks like, “It looks like”, THEN describe its parts. What do you see? Rocket, house, face, dog etc.
10. Modelling barrier game in the groups of 4 where educator is one of the four people playing the game.

Activity 1: Body Benchmarks

Learning Goal:

- Students will learn positional language and demonstrate understanding in kinesthetic and verbal ways.

Materials:

- Students bean bags – one per child

Look for/listen for:

- Student follows direction according to the language used (ie: on top, bird’s eye view, side, front, back behind, or below)
- Students repeat language as they are engaged in the activity
- Students explain how language matches with the position of the bean bag
- Students gesture position before placing bean bag

Lesson Overview:

1. Using Simon says, use positional language to indicate where the bean bag is situated with respect to children’s bodies. Make intentional errors as the instructor as you play along.

2. A next step would be to lead from a different position in the classroom; outside or in the gym, for example. Consolidate that the position of the bean bag does not change with respect to the body, regardless of the change in position of the body or environment.

Key questions:

- “Why do some of you have the bean bag (describe position)?”
- “What would you change about where my bean bag is?”
- “How do you know if you are on the right track?”
- “Now that we have changed our position/environment, does that change where I place the bean bag?”

Activity 2: Picture Perspective Sorting

Learning Goals:

- To consolidate the positional terms and reinforce the use of these terms with pictures of objects.

Materials:

- Picture Cards (See Below)
- Positional Terms Name Cards (PDF Attached) (Front, Behind, Top/Birds Eye View, Side, Bottom)

Lesson Overview:

1. Review Positional terms by playing Simon Says. Have students place their hands on the locations of their body to review the terms front, behind, top, bottom, side).
2. Show students the Positional Term Cards. As they are introduced have students put their hands in this location.
3. Show students a few sample picture cards and have the students put their hands on their bodies in the location that shows.
4. Have pairs or small groups of students sort the pictures with the positional terms cards at the top with the rows of pictures underneath. Use questions such as “How do you know...” to provide students opportunities to explain their thinking.



Activity 3: Hoop Play

Learning goal:

- Students will learn positional language and demonstrate it kinesthetically.

Materials:

- Hula hoop
- bean bags

Lesson Overview:

1. Start with Simon Says and position of the bean bag with respect to their bodies.
2. Next, use positional language to indicate where students are in relation to the hoop.
3. Ask students to use the bean bag to show its position against the hoop.

Look fors/listen fors:

- Appropriate use of positional language
- Gestures to indicate various positions
- Kinesthetic movement to indicate positions
- Students may put their bean bags next to them in the hoop
- Students may place themselves in the hoop when asked to move beside it

Key questions:

- “Who can use their words to explain why the bean bag/hoop is (describe position)?”
- “Why did you change the position of the bean bag/hoop?”
- “Where is a better place to place your body? How can your position match the words I use?”
- “How can we all agree on (matching language to position)?”

Activity 4: Where am I?

Learning Goals:

- Students will use visual images to determine location and describe their position.

Materials:

- Pictures of classroom, from different angles at the student’s height
- iPads for student pictures
- Extension will include photos of the playground

Lesson Overview:

1. In small groups, teacher shows picture to students.
2. Students walk to location in room and explain why they chose this location and characteristics of picture.
3. Next, students work in pairs to take photos of a location in class for their partner to guess.
4. The teacher takes half of the group to “hide” while the others take a picture and return to group.
5. They show their picture to their partner and the partner goes to the location of the picture to indicate their guess.
6. They explain to their partner why they chose the particular location.
7. As an extension, show pictures of outdoor perspectives, then students may do the same activity above on the playground.

Look fors/listen fors:

- “You were at the front/back/side/etc., of the (area of the room)”
- Students move to location
- Students choose location and take photo in room to show this

Key questions:

- “How do you know you are in the right location?”
- “What are your clues?”
- “Describe what you see.”
- “When I took this photo, was I standing in front of/behind/beside, etc. the?”

Activity 5: Do the iPad Shuffle

Learning goal:

- Students will use visual images to provoke language and gesture use to describe positional location.

Materials:

- iPads (you can use simple pictures)
- Structure in the middle with figure on top
Variation:
 - Put the figure to the side of the structure

Lesson Overview:

1. Provide a structure for a small group, with a figure on the top to provide a marker for the students. (Take pictures without students present of each of the four sides and keep these on the iPad.)
2. Shuffle the iPads on the carpet, giving each student an iPad with a photo to match the structure. They are to sit on the side of the figure where they believe the picture was taken. Students explain their thinking.
3. Repeat the process with a second structure, only with the figure to the side to provoke more conversation.

Look fors/listen fors:

- Use of visual images to match up with the perspective of the photograph
- Language and gesture use to indicate perspective of photograph
- Students moving kinesthetically around the structure to match the photo
- Recognizing features of the structure from different perspectives

Key questions:

- “How do you know...?”
- “What were your clues?”
- “What would we call that?”
- “Are you beside/behind/in front of the structure... ?”

Activity 6: Build it in your mind

Learning Goals:

- To practice composing and decomposing 3D objects, receptive spatial language, and spatial visualization.

Materials/preparation:

- Picture Cards of simple interlocking cube structures (attached)
- Prior to completing this activity, students should be familiar with visualizing. For example, have students visualize putting rocks in a bucket, putting sunscreen on their bodies, getting dressed for outdoor play time. These simple visualization activities can be done throughout the year with objects and routines they are familiar with.
- Refer to “Taking Shape – Activities to Develop Geometric and Spatial Thinking Grades K-2” Lesson 2, Page 160.

Activity 7: Barn Game Barrier

Learning Goal:

- To provide opportunities for students to use positional language in a familiar and concrete context and provide an introduction to barrier games.

Materials:

- Barn
- Fences
- a variety of barnyard animals.
- Presentation Display board for barrier.

Lesson Overview:

1. Review positional terms from previous activities.
2. Introduce the game whole group and model playing the game with one student. Describe the placement of all animals. Here are some examples:
“Place the cow beside the pig”
“Put the sheep on top of the barn”
“Put the horse behind the fence”
3. Students take turns being the caller and the child manipulating the animals.
4. Have students play the game in pairs.
5. Repeat activity adding pattern blocks so students become familiar with describing the shapes (e.g., put the green triangle beside the cow).

Look Fors:

- Use of positional terms, gestures, receptive language, spatial visualization

Activity 8: Barrier Game

Refer to Taking Shape pg 182 Introductory Barrier Game

Activity 9: Gestalt Exercise

Learning Goal:

- Students will interpret images of clouds to describe these to others using language and gestures. This will prepare them for the Barrier Game.

Materials:

- Images from the internet (ie: “Lenny’s World ... cloudy ideas” at <http://lennys-world.blogspot.ca/2011/06/cloudy-ideas.html> or <https://www.google.ca/search?q=Lenny%27s+world+->

[+clouds&source=Inms&tbm=isch&sa=X&ved=0ahUKEwj1ipGlxIbUAhVCx1QKHb-tB1gQ_AUIBigB&biw=1366&bih=625&dpr=1#tbm=isch&q=pictures+of+clouds+that+look+like+animals&spf=1495560458936\)](https://www.google.com/search?q=pictures+of+clouds+that+look+like+animals&source=Inms&tbm=isch&sa=X&ved=0ahUKEwj1ipGlxIbUAhVCx1QKHb-tB1gQ_AUIBigB&biw=1366&bih=625&dpr=1#tbm=isch&q=pictures+of+clouds+that+look+like+animals&spf=1495560458936)

- Extension: Child’s creation can be used to describe perspectives using gestures and positional language.

Lesson Overview:

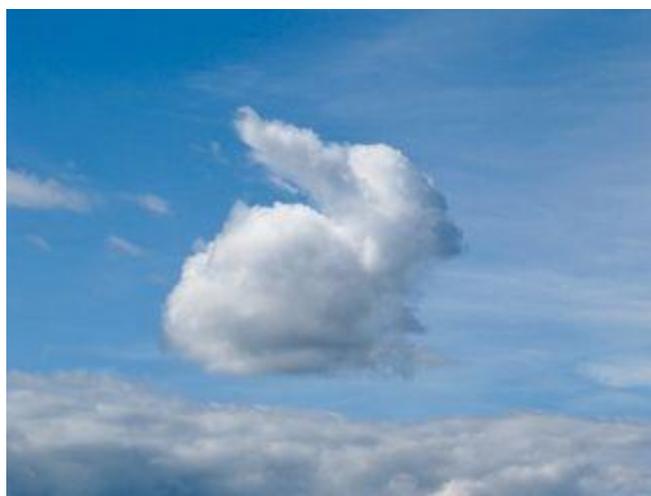
1. The teacher provides thought provoking images of clouds for students to observe.
2. Students will use their imagination to explain what they see (e.g., images in the clouds). Students should use descriptive language and positional language to describe the image they see within the clouds.
3. Extension: Students describe student-created structures using gestures and positional vocabulary.

Look fors/listen fors:

- Students will make connections to personal experiences
- Students will use descriptive language, including positional vocabulary
- Students will use gestures to communicate
- Students will build on one another’s ideas

Key questions:

- “Why do you think that?”
- “What part are you looking at?”
- “What made you think of that?”
- “How does this connect to your life?”
- “Does anyone else connect to’s idea?”
- “Is this the side/front/back, etc. view of the image?”





Activity 10: Barrier Game

Learning Goal:

- position, orientation, and location; positional and directional spatial language; perspective taking (p.g. 182 Taking Shape)

Materials:

- face templates
- Pattern blocks

Lesson Overview:

- Students will pair up, one will be the designer the other will be the builder.
- Designer will look at the patten picture provided and verbally describe the position and shape of the picture in front of them.
- The pattern is a face, the student may or may not use this as a descriptive tool in order to achieve success.

Look fors:

- refer to page 186 Taking Shape Assessment for Reporting

Exploratory Tasks Set 4: Playground Perspectives **FOCUS: Emotional-social perspective taking**

Learning Goal:

- positional-relational language, spatial-visualization, using perspective to locate and describe

Materials:

- Perspective photographs of various classroom/playground sites
- Scavenger Hunt checklist
- Cameras/ipads for students to take photos (if desired)

Lesson Overview:

1) **Intro:**

- (i) Show students photos from various places in the classroom. Ask them,
“Where might this photo have been taken from?”
- (ii) Students could move around the classroom to verify their responses. You might also have students describe what they see from different places in the classroom.

- (iii) Develop the positional/perspective language with students. *On top, beside, behind, under* etc.

2) a) Playground Scavenger Hunt:

- (i) Create a picture series of various playground sites for students to find in a scavenger hunt. (ie. From the top of the slide, from under the basketball net etc.)

Possible variations:

- Students could have a checklist or could match pictures to descriptions.
- Give students a list of descriptions and they must take a photo themselves from each spot; this could lead into a good discussion if students have different pictures resulting from the same description!
- Give students one location, and they must take photos from different perspectives of that location. They can later verbalize each perspective to the class or teachers.

-AND/OR-

b) Schoolyard Clean-Up:

- (i) Facilitate a discussion around different perspectives of your school yard.

“What do I see if I’m standing at this door?”

“What does this neighbour see if they are looking at our schoolyard?”

“As a visitor, if you arrived at the school this way, what would you see?”

“Why might this area have more litter than another area?”

- (ii) You can highlight the importance of perspective, a focus on healthy living, being respectful to each other and our environment, empathy!
- (iii) Take pictures of different areas of the schoolyard. Children can work in pairs, find their given area from the picture, and clean that area of the yard! They might take After photos from the same perspective.

Watch For/Listen For:

- What language are students using to describe different perspectives?
- Are students using gestures to express different perspectives?
- Are students moving/orienting themselves to aid in perspective-taking?
- Are students able to visualize different perspectives without physical movement?

OBSERVATION GUIDES

Sample Observation Guide #1:

Spatial Thinking Observations

Student Name: _____

Date: _____

Look For	Notes
Spatial language used: direction, position, mirror, flip, same, different, bigger, smaller	
Gestures: Pointing, whole hand, full body, symmetrical, gesture, turning, rotating, spinning, balance	
Physical representations: What are they doing with the materials? How are they using materials to represent space, occupy space, and create open space? How are they using their body and space in relation to the materials?	
3D moving into 2D: (e.g., birds eye view, can they transfer an image of a 3D structure to 2D representation on chart paper?)	

Sample Observation Guide #2:
Perspective Taking

<p>Expressive (e.g., language/verbal communication)</p>	<p>Receptive (e.g., understanding)</p>
<p>Physical (e.g., gestures/non-verbal communication)</p>	<p>Metacognitive (e.g., reflection, connection)</p>